

Working Well Under Pressure Recent Explosive Decompression Seals Developments

When it comes to down-hole tool, pump, compressor, valve and pipeline sealing - the offshore oil and gas industry wants it all. Elastomer seals that last longer, and never fail in the most extreme environments. John Kerwin, materials technology manager at high performance elastomer seals maker Precision Polymer Engineering reviews the latest developments in explosive decompression resistant seals, and has some encouraging news for operators and contractors.

Elastomer or rubber seals used in oil and gas equipment are subject to a wide range of extremes: temperatures between +260°C and -40°C, mixtures of gases: carbon dioxide, methane, hydrogen sulphide, and nitrogen which, together with pressures up to 15,000psi, produce gas mixtures with extraordinary solvent power. Of course these are only the 'headline' environmental requirements. The seal is also subject to exposure to steam, acids, amine inhibitors and alcohols, abrasive muds and rapid pressure changes, all of which are potentially damaging to seals.

Once the 'basics' of temperature and chemical resistance have been met, it's the ability of the elastomer seal to withstand rapid pressure changes that presents the biggest challenge. Explosive decompression (ED) can occur when gas permeates into an elastomer under high pressure and the pressure is released rapidly. The pressurised gas expands suddenly and ruptures the elastomer in a catastrophic manner.

The extent of a seal's ED resistance is a mix of the choice of elastomer, design and manufacture. Design is important in ensuring the seal fits, and can be installed, correctly. A poorly designed seal will introduce stresses that could weaken the polymer structure making it more vulnerable to explosive decompression. Similarly high quality seal moulding processes are essential to prevent micro cavities being formed that can weaken the elastomer structure, during seal manufacture.

As will be clear by now, selecting an ED resistant seal is dependent upon multiple variables and, at some point, a trade-off in physical, mechanical, chemical and explosive decompression performance has to be made.

Recent elastomer developments have been aimed at reducing the degree of trade-off companies need to make when selecting ED seals. This has been achieved by taking available explosive decompression resistant elastomers such as TFE/P, HNBR, and FKM polymers and improving their formulation and characterisation. As a result there have been significant improvements in low temperature vs high pressure performance and mechanical performance of elastomer seals in explosive decompression situations.

Until recently it was not uncommon for traditional ED o-ring seals to fail catastrophically above 180 bar at -25°C. Today valves fitted with new ED resistant elastomer o-rings are capable of achieving: -46°C, +200°C, 345 bar in 100% methanol without failure.

Similar improvements have been made in improving the mechanical performance of ED seals. For example, two 4-cylinder and four 6-cylinder HOS reciprocating compressors, located on three floating platforms, and operating at 150°C, at a pressure of 200 bar with a decompression to 12 bar in 1 minute would fail after just 10 cycles. The gas leaks resulted in the compressors having to be stopped, so causing explosive decompression on the valve head seals (from 3,000 revs to stop in 6 seconds). Due to HSE safety concerns, the compressors were required to achieve at least 30 cycles before failure.

Using a combination of FKM L-shaped ED seal with PTFE back-up ring to provide high levels of resistance to explosive decompression, the compressors were operated without a single leak occurring for 30+ cycles consistently. On removing the FKM seals after use they were found to be completely intact, showing little sign of explosive decompression.

Further work is now in progress to develop an ED improved perfluoroelastomer (FFKM) that is suitable for environments up to 260°C.

For more information on Explosive Decompression Seals contact John Kerwin on +44 (0)1254 295400 and john.kerwin@prepol.com or visit www.endura-seal.com.

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